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Preliminary	Quanta Display Inc. SPECIFICATION	Doc No. QD23HL0201 Doc. REV.: 07 Issue Date:Apr.28,'05 With RoHS compliant

Specification for TFT LCD Module

Model No.
QD23HL02 Rev.:01

☐ Customer's Approval

Date _____

by _____

Approved By _____

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Revision History			
REV.	Date	ECN NO.	Change Content
1	Nov/01/2004	N/A	Preliminary specification Initiate
2	Jan/25/2005	N/A	1. update the model no. (p.5) 2. update the weight (p.5) 3. modify the LVDS connector pin assignment (p.6) 4. update "Interface block diagram" (p.7) 5. update the lamp connector (p.8) 6. update the TFT LCD panel driving parameter (p.10) 7. update the lamp spec (p.11) 8. update the lamp wire length (p.12) 9. update the inverter electrical characteristics (p.12) 10. update the uniformity spec (p.17)
3	Feb/23/2005	N/A	1. Modify the inverter connector spec (p.8) 2. Update the rush current spec (p.10) 3. Modify the lamp spec (p.11) 4. Modify the inverter electrical characteristics (p.12) 5. Modify the lum control freq. (p.14)
4	Mar.16,'05	N/A	Page 6, pin 9 support NS only, page 7, update diagaram block, page 15, update timing, page 17, update uniformity.
5	Mar.24,'05	N/A	Page 11, update lamp current, Page 15, update timing, page 17, update optical spec.
6	Apr.07,'05	N/A	Page 24 , update barcode position in back cover.
7	Apr. 28,'05	N/A	Page 11, lamp current change from 5.6 to 5.2mA typ., page 14, PWM frequency change from 190~210 to 150~350Hz.

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1. Application

This specification applies to a color TFT-LCD module, QD23HL02

2. Overview

This module is a color active matrix LCD module incorporating amorphous silicon TFT (Thin Film Transistor). It is composed of a color TFT-LCD panel; driver ICs, control circuit and power supply circuit and a backlight unit. Graphics and texts can be displayed on a 1366×3×768 dots panel with 16.7 million colors by using the LVDS (Low Voltage Differential Signaling) interface, 8-bit driving method and supplying +12V DC supply voltage for TFT-LCD panel driving.

The TFT-LCD panel used for this module has very high aperture ratio. A low-reflection and higher-color-saturation type color filter is also used for this panel. Therefore, high-brightness and high-contrast image, which is suitable for the LCD TV,HDTV and multimedia use, can be obtained by using this module.

[Features]

1) High-brightness
2) Brilliant and high contrast image.
3) High speed response
4) WXGA resolution. 16:9
5) LVDS interface.

3. General Specifications

Parameter	Specifications	Unit
Display size	58.30 (23") Diagonal	cm
Active area	508.152 (H)×285.696 (V)	mm
Pixel format	1366 (H)×768 (V)	Pixel
	(1 pixel = R+G+B dots)	
Pixel pitch	0.372 (H) × 0.372 (V)	mm
Pixel configuration	R,G,B vertical stripe	
Display mode	Normally White	
Unit outline dimensions	546 x 318.3	mm
Thickness	Max. 46	mm
Weight	3300 (max)	g
Surface treatment	Anti-glare(26%) and hard-coating 3H	
Lamp Quantity	6 U shape	pcs

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4. Input Terminals

4-1. TFT-LCD panel driving

CN1 (LVDS signals and +12V DC power supply)

Connector on Panel : FI-X30SSL-HF(Manufactured by JAE) or Equivalent

Mating connector : FI-30C2L (Manufactured by JAE) or Equivalent

Pin No	Symbol	Description	Default
1	VCC	+12V, DC, Regulated	
2	VCC	+12V, DC, Regulated	
3	VCC	+12V, DC, Regulated	
4	VCC	+12V, DC, Regulated	
5	GND	Ground and Signal Return	
6	GND	Ground and Signal Return	
7	GND	Ground and Signal Return	
8	GND	Ground and Signal Return	
9	LVDS	Support NS only	
10	Reserved	N.C.	
11	GND	Ground and Signal Return for LVDS	
12	RXIN0-	LVDS Channel 0 negative	
13	RXIN0+	LVDS Channel 0 positive	
14	GND	Ground and Signal Return for LVDS	
15	RXIN1-	LVDS Channel 1 negative	
16	RXIN1+	LVDS Channel 1 positive	
17	GND	Ground and Signal Return for LVDS	
18	RXIN2-	LVDS Channel 2 negative	
19	RXIN2+	LVDS Channel 2 positive	
20	GND	Ground and Signal Return for LVDS	
21	RXCLKIN-	LVDS Clock negative	
22	RXCLKIN+	LVDS Clock Positive	
23	GND	Ground and Signal Return for LVDS	
24	RXIN3-	LVDS Channel 3 negative	
25	RXIN3+	LVDS Channel 3 positive	
26	GND	Ground and Signal Return for LVDS	
27	Reserved	N.C.	
28	Reserved	N.C.	
29	GND	Ground and Signal Return	
30	GND	Ground and Signal Return	

【Note 1】All GND(ground) pins should be connected together.

【Note 2】All V_{DD} (power supply) pins should be connected together.

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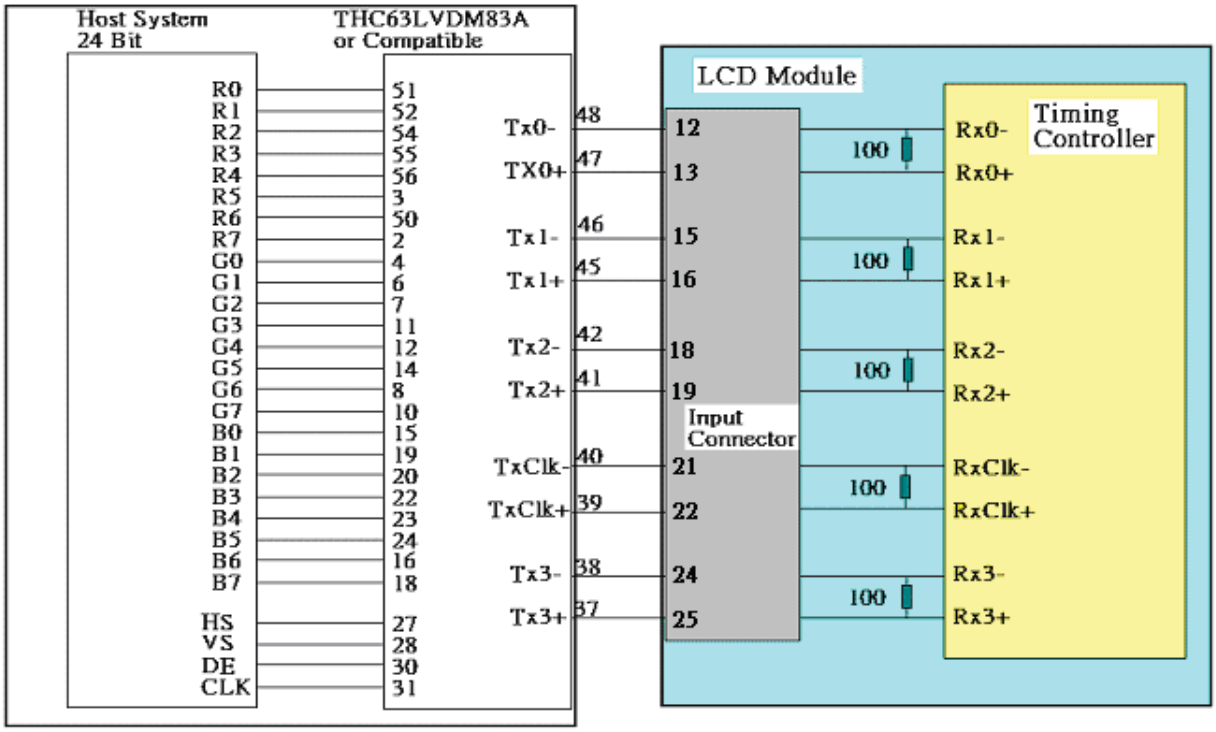
4-2 Interface block diagram



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4-3. Backlight driving

4-3-1. Inverter Connector

Connector on Inverter : S14B-PH-SM3(Manufactured by JST) or Equivalent

Mating connector : PHR-14 (Manufactured by JST) or Equivalent

Pin No	Symbol	Description	Default
1	VIN	Operating Voltage Supply, +24V DC regulated	24V
2	VIN	Operating Voltage Supply, +24V DC regulated	24V
3	VIN	Operating Voltage Supply, +24V DC regulated	24V
4	VIN	Operating Voltage Supply, +24V DC regulated	24V
5	VIN	Operating Voltage Supply, +24V DC regulated	24V
6	BLGND	Ground and Current Return	GND
7	BLGND	Ground and Current Return	GND
8	BLGND	Ground and Current Return	GND
9	BLGND	Ground and Current Return	GND
10	BLGND	Ground and Current Return	GND
11	ADIM(1)	GND (0V) 80% Lum / Open (1.6V) 100% Lum / High (3.3V) 120% Lum	100%
12	ON/OFF	BL On-Off: Open/High (3.3V) for BL On as default	On
13	PDIM(2)	PWM Dimming: Open/High (3.3V) for 100% Lum Analog Dimming: GND (0V) 20% Lum/ Open or High (3,3V) 100% Lum	100%
14	PWM Selection(3)	GND: Duty Signal to 13pin, Open/High(3.3V): Analog Voltage to 13 pin	Analog

[Note]

(1) ADIM is control signal for Inverter's output Power to Back Light Lamp Bulb. Input Signal should be able to control Amplitude of Inverter Output voltage. From 0V to 3.3V, Inverter Output Voltage should be able to vary to control Brightness of Lamp from 80% to 120% Luminescence variation.

(2) PDIM is PWM control input; i.e. for the given ADIM, this PDIM input should be able to control Width of Voltage Burst of inverter output for Lamp Driving. This input can have two type of input; Ordinary default setting will be DC level signal using Saw Tooth Wave control for PWM duty control. The other setting is Duty Signal Input with 3.3V TTL specification. These two method should be decided by 14th Pin input setting.

(3) 14 Pin is selection pin for PWM control method; if this pin is connected to GND, PDIM input of 13th Pin should have Logic Level Duty Signal for PWM control. If this is set to High or Open,

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13th Pin should have DC level signal therefore the Inverter should have Saw Tooth Wave Generator to generate internal PWM signal. Default setting is "Analog", means when it is "Not Connected", 13th pin of PWM control should be have DC Level signal for PWM.

4-3-2. Lamp connector

Back Light Lamp Connectors and Pin Assignment are as follows.

Connectors attached to Lamp Lead : BHR-04VS-1(JST)

Mating connectors for Inverter output : SM02(12.0)B-BHS-1-TB(JST) or 4002P0220T(LANDWIN)

Pin No	Symbol	Description	Default
1	CFL HOT	High Voltage AC Signal	
2	N.C.	Spacing for High Voltage Clearance	
3	CFL HOT	Return for High Voltage AC Signal	

5. Absolute Maximum Ratings

LCD module

Parameter	Symbol	Condition	Ratings	Unit	Remark
+12V supply voltage	V_{DD}	Ta=25℃	-0.3 ～ +14.0	V	
Storage temperature	Tstg	—	−30 ～ +70	℃	【Note1】
Operating temperature (Ambient)	Topa	—	0 ～ +60	℃	

【Note1】Humidity : 90%RH Max. at Ta≦40℃

Maximum wet-bulb temperature at 39℃ or less at Ta>40℃.

No condensation.

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6. Electrical Characteristics

6-1.TFT-LCD panel driving

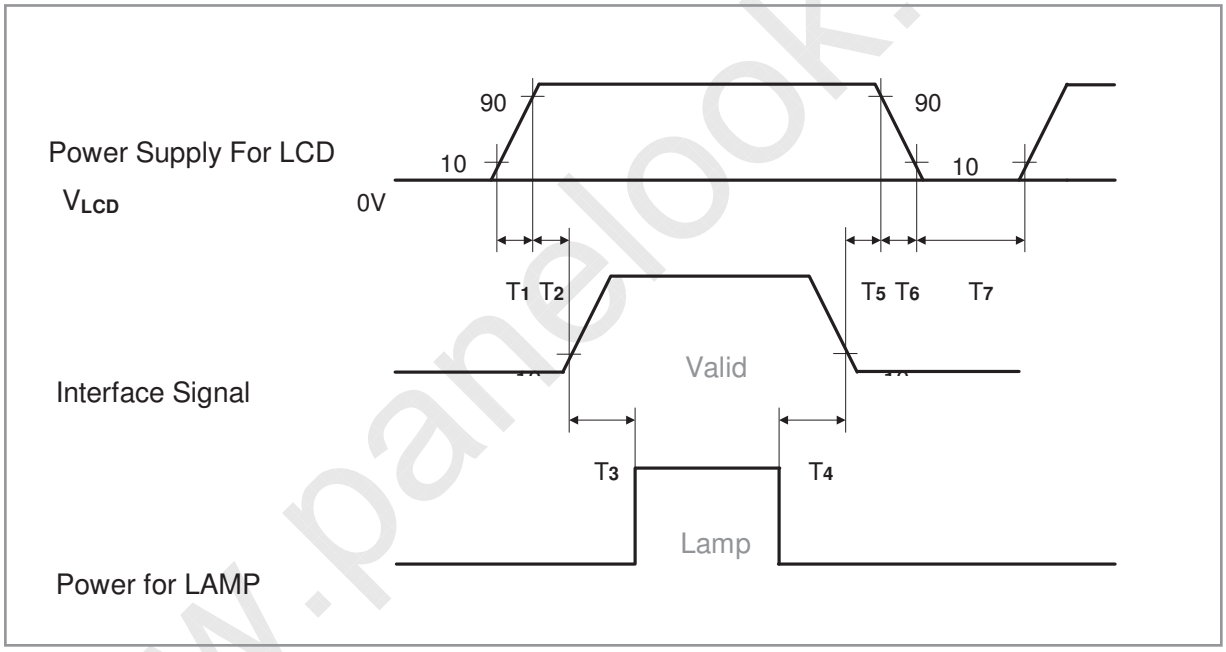
Ta＝25℃

Parameter		Symbol	Min.	Typ.	Max.	Unit	Remark
V_{DD}	Supply voltage	V_{DD}	+11.4	+12.0	+12.6	V	【Note2】
	Current dissipation	I_{DD}	—	280	400	m A	【Note3】
Permissive input ripple voltage		V_{RP}	—	—	100	mV p-p	V_{DD}=+12V
Differential input threshold voltage	High	V_{TH}	—	—	100	mV	V_{CM}=+1.2V 【Note1】
	Low	V_{TL}	-100	—	—	mV	
Rush current		I_{RUSH}			2	A	Rise Time 470uS

【Note1】 V_{CM} : Common mode voltage of LVDS driver.

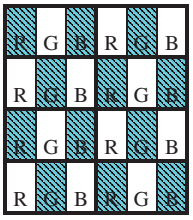
【Note2】

Power On-off sequence



1ms＜ T1,T6 ≦10 ms ; 0.5ms＜ T2,T5 ≦50 ms ; 200ms＜T3,T4 ; T7＞1 s

【Note3】 Maximum current condition; Change to 1x1 dot checker board pattern. V_{DD}=+12V



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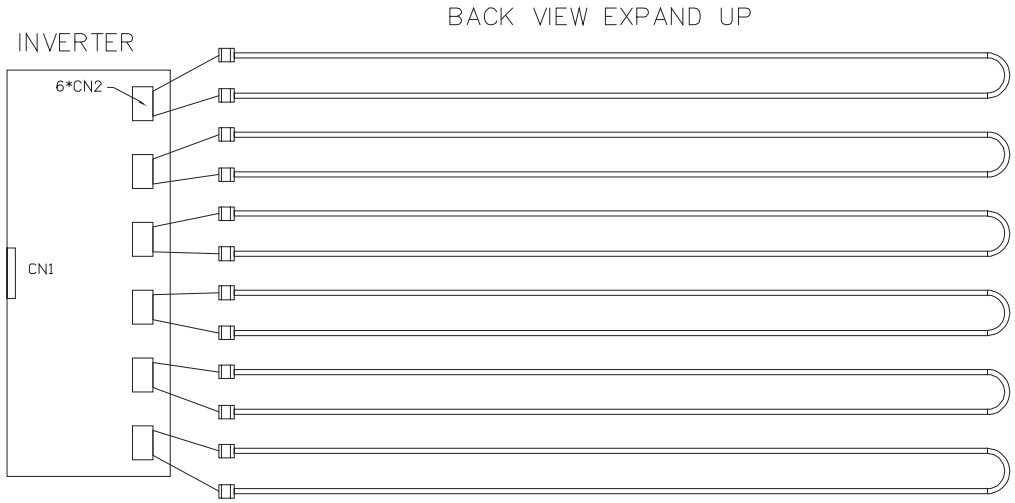
6-2. Backlight driving

The backlight system is a direct-lighting type with 6 U shape CCFT (Cold Cathode Fluorescent Tube).

The characteristics of the lamp are shown in the following table.

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark	
Lamp current range	I_L	4.7	5.2	5.7	mArms	【Note1】	
Lamp voltage	V_L		1780		Vrms		
Lamp power consumption	P_L		9.3		W	【Note2】 IL=5.2mA	
Lamp frequency	F_L		57		kHz	【Note3】	
Established starting voltage	Vs		2350		Vrms	Ta=25℃	
			2810		Vrms	Ta=0℃	【Note4】
Lamp life time	L_L	50000			hour	Lum ratio:100%	【Note5】
		40000			hour	Lum ratio:120%	【Note5】

【Note1】 Lamp current is measured with current meter for high frequency as shown below.



【Note2】 Calculated Value for reference (I_L × V_L)

【Note3】 Lamp frequency may produce interference with horizontal synchronous frequency, and this may cause beat on the display. Therefore lamp frequency shall be detached as much as possible from the horizontal synchronous frequency and from the harmonics of horizontal synchronous to avoid interference.

【Note4】 The voltage above this value should be applied to the lamp for more than 1 second to start-up. Otherwise the lamp may not be turned on.

【Note5】 Lamp life time is defined as the time when either ① or ② occurs in the continuous operation under the condition of Ta = 25℃ and I_L = 6mArms.

① Brightness becomes 50 % of the original value under standard condition.

② Kick-off voltage at Ta = 0℃ exceeds maximum value.

【Note6】 The performance of the backlight, for example life time or brightness, is much influenced

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by the characteristics of the DC-AC inverter for the lamp. When you design or order the inverter, please make sure that a poor lighting caused by the mismatch of the backlight and the inverter (miss-lighting, flicker, etc.) never occur. When you confirm it, the module should be operated in the same condition as it is installed in your instrument.

【Note7】The lamp wire length is 23+/-3mm(from AL back cover surface to connector, not including connector length)

6-3 Backlight inverter

6-3-1. Inverter Electrical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Power Supply Input Voltage	V_{DDB}	22.8	24	26.4	Vdc	
Power Supply Input Current	I_{DDB}		2.5		A	TBD
Power Consumption	P_B		60		W	TBD

6.4 Luminance Controls

Method	Adjustment and Luminance Ratio	PWM Selection	Remark
Voltage control	Adjustment – Continuous adjustment of Luminance by adjusting the voltage	High/Open for max.	
PWM control	Adjustment- The luminance is controlled by duty ratio of BRTP signal when PWM Selection is GND and PWM signal is inputted into BRTP termial.	GND	See PWM timing

PDIM \ ADIM (Lum ratio)	0V	1.6V/open	3.3V
3.3V	80%	100%	120%
0V		20%	

Duty Ratio	Luminance Ratio
0.2	20%(minimum)
1.0	100% (maximum)

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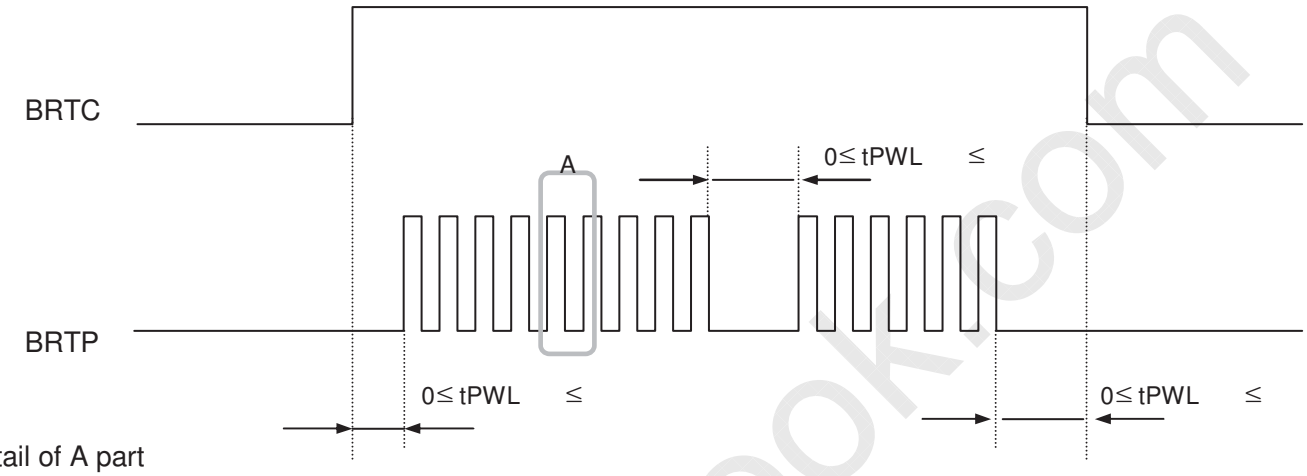
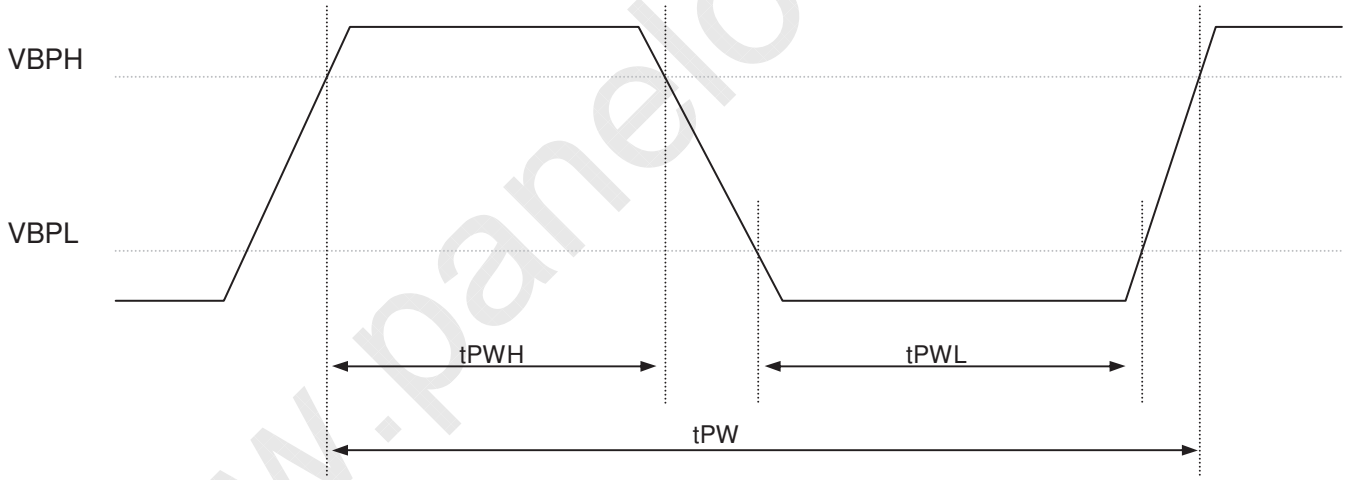
6-5. PWM timing

6-5-1. Timing diagram

- Outline chart



- Detail of A part



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6-5-2. Each parameter

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Luminance control fequency	FL	150		350	Hz	1, 2
Duty Ratio	DL	0.2	-	1.0	-	1, 3
Non signal Period	tPWL	0	-	50	Ms	4

Notes : 1. Definition of parameters is as follows

$$FL = \frac{1}{tPW} \quad , \quad DL = \frac{tPWH}{tPW}$$

2. See the following formula for luminance control frequency.

Luminance control frequency = tvv X (n+0.25)[or(n+0.72)]

n=1,2,3,……

tvv : See “7.1 Signal timing specification”

The interference noise of luminance control frequency and input signal frequency for LCD panel signal processing board may appear on a display. Set up luminance control frequency so that the interference noise does not appear.

3. See “6.4 Luminance control methods”

4. If tPWL is more than 50ms, the backlight will be turned off by a protection circuit for inverter.

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7. Timing characteristics of LCD module input signals

7-1. Timing characteristics

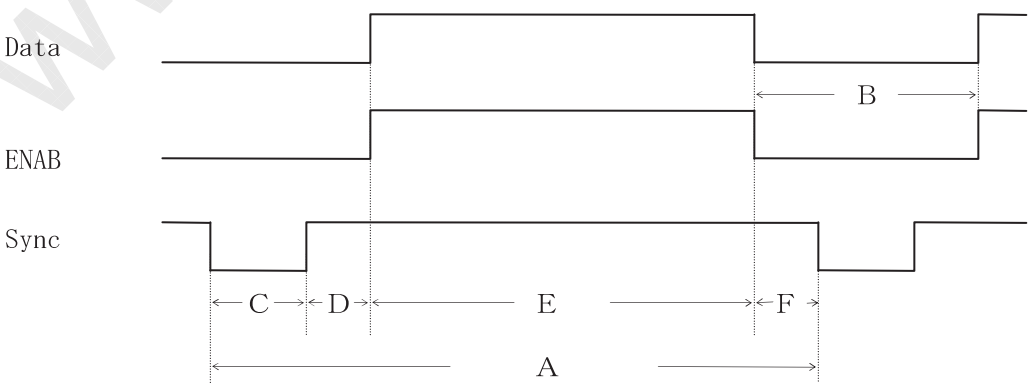
(This is specified at digital outputs of LVDS driver.)

ITIME	Symbol		Min	Typ	Max	Unit	Notes
DCLK	Frequency	F_{CLK}	53	80	82	MHz	
	Period	t_{CLK}	12.2	12.5	18.8	ns	
Hsync	Frequency	f_H	35	48.54	55	KHz	
	Period	t_{HA}	1482	1648	1780	t_{CLK}	
	Width-Active	t_{HC}	8	16	-	t_{CLK}	
Vsync	Frequency	f_V	47	60	72	Hz	
	Period	t_{VA}	771	810	-	t_{HA}	
	Width-Active	t_{VC}	1	6	-	t_{HA}	
Data Enable	Horizontal back porch	t_{HD}	8	80	-	t_{CLK}	
	Horizontal front porch	t_{HF}	100	186	-	t_{CLK}	
	Horizontal active	t_{HE}	1366	1366	1366	t_{CLK}	
	Horizontal blanking	t_{HB}	116	282	-	t_{CLK}	
	Vertical back porch	t_{VD}	1	20	-	t_{HA}	
	Vertical front porch	t_{VF}	1	16	-	t_{HA}	
	Vertical active	t_{VE}	768	768	768	t_{HA}	
	Vertical blanking	t_{VB}	3	42	-	t_{HA}	

Notes : 1.The performance of electro-optical characteristics may be influenced by variance of the vertical refresh rate.

2. Hsync period will be a double number of character (8).

7-2 Signal Timing Waveform(The time "B" is t_{HB} on horizontal timing and t_{VB} on vertical timing)



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8. Input Signals, Basic Display Colors and Gray Scale of Each Color

	Colors & Gray scale	Data Signal																			
		R0	R1	R2	R3	R4	R5	R6	R7	G0	G1	G2	G3	G4	G5	G6	G7	B0	B1	B2	B3	B4	B5	B6	B7
Basic Color	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Cyan	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Gray Scale of Red	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇧	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Darker	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇧				↑								↑								↑				
	⇩				↓								↓								↓				
	Bright	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇩	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gray Scale of Green	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇧	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Darker	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇧				↑								↑								↑				
	⇩				↓								↓								↓				
	Bright	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	⇩	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Gray Scale of Blue	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇧	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	Darker	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	⇧				↑								↑								↑				
	⇩				↓								↓								↓				
	Bright	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1
	⇩	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

0 : Low level voltage, 1 : High level voltage

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9. Optical Characteristics

Ta=25℃, V_{DD}=+12V

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing angle range	L/R	θ 21, θ 22	CR>10	65	70		Deg.	【Note1,4】
	U	θ 11		50	65		Deg.	
	D	θ 12		55	60		Deg.	
Contrast ratio		C R n	θ =0°	400	450	—		【Note2,4】
Response time		τ		—	16	21	ms	【Note3,4】
Rise time	τ r				6	11	ms	
Fall time	τ d				10	15	ms	
Chromaticity of White (CIE 1931)		Wx		0.242	0.272	0.302		【Note4】 Color temperature 12000K
		Wy		0.248	0.278	0.308		
Chromaticity of Red (CIE 1931)		Rx		0.602	0.632	0.662		NTSC 72%
		Ry		0.306	0.336	0.366		
Chromaticity of Green (CIE 1931)		Gx		0.234	0.264	0.294		
		Gy		0.573	0.593	0.623		
Chromaticity of Blue (CIE 1931)		Bx		0.114	0.144	0.174		
		By		0.028	0.058	0.088		
Luminance of white 【Note4】		Y_L		450	500		Cd/m^2	
Gamma curve					2.2			
White Uniformity		δ_W		—	-	1.3		【Note5】
Black Uniformity		δ_B				1.3		【Note5】

※ The measurement shall be executed 30 minutes after lighting at rating. (typical condition : I_L = 5.2mArms)

The optical characteristics shall be measured in a dark room or equivalent state with the method shown in Fig.1 below.

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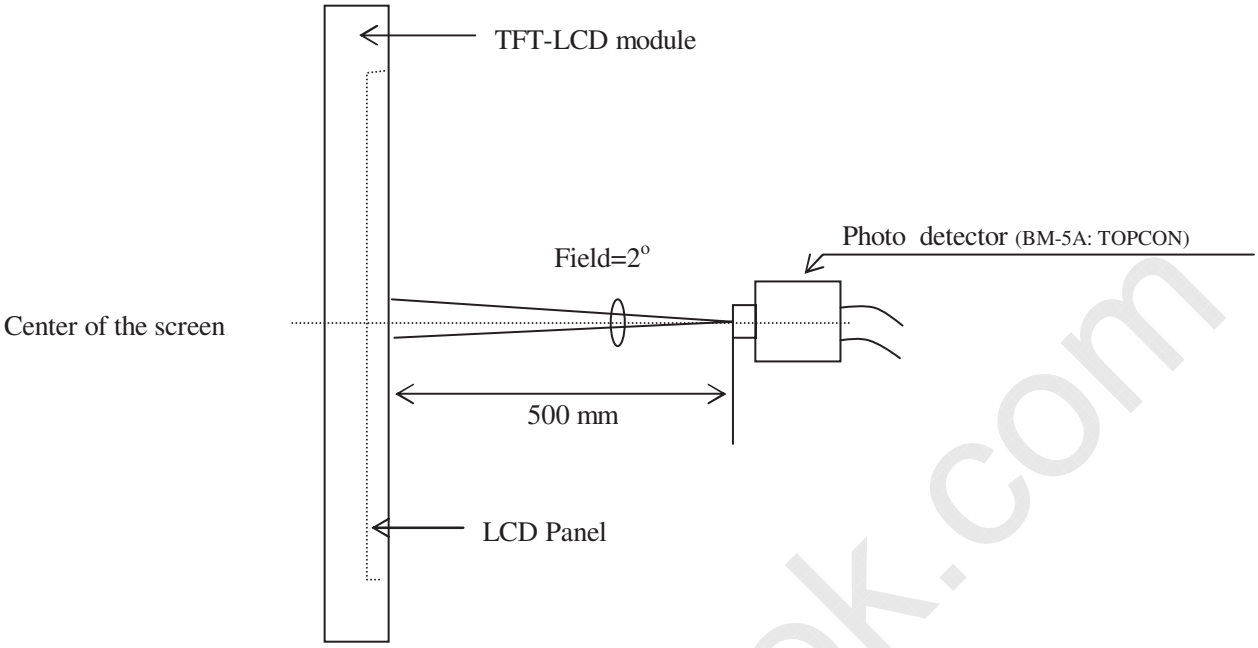
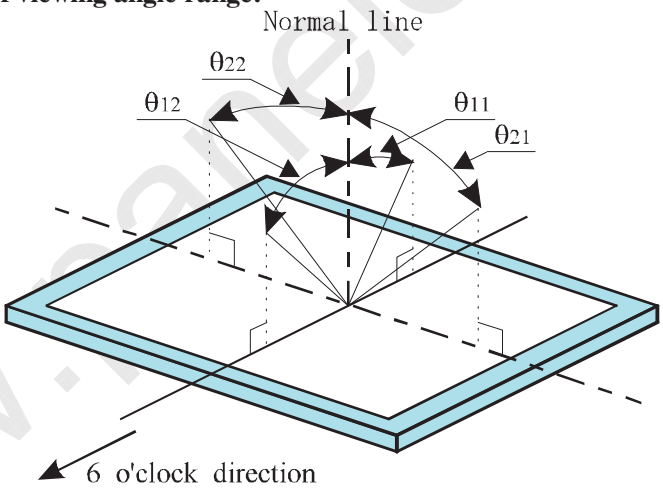


Fig 1. Optical characteristics measurement method

【Note1】Definitions of viewing angle range:



【Note2】Definition of contrast ratio:

The contrast ratio is defined as the following.

$$\text{Contrast Ratio (CR)} = \frac{\text{Luminance (brightness) with all pixels white}}{\text{Luminance (brightness) with all pixels black}}$$

【Note3】Definition of response time:

The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white" .

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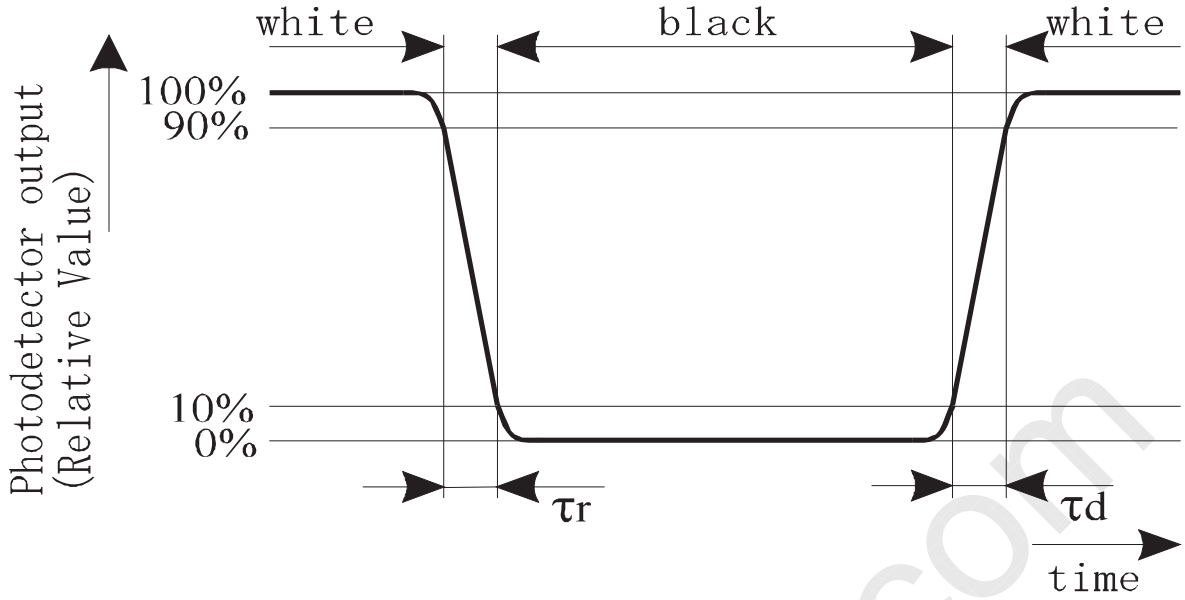
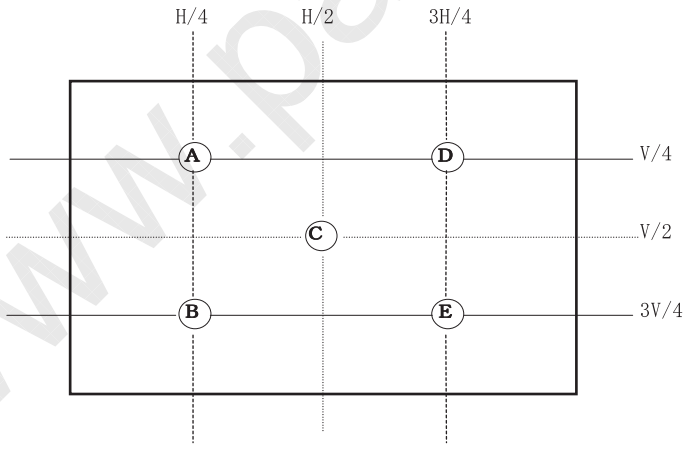


【Note4】This shall be measured at center of the screen.

【Note5】Definition of white uniformity:

White and black uniformity is defined as the following with nine measurements



$$\delta_{W,B} = \frac{\text{Maximum Luminance (of 5 points measurement)}}{\text{Minnum Luminance (of 5 points measurement)}}$$

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10. Display Quality

The display quality of the color TFT-LCD module shall be in compliance with the Incoming Inspection Standard.

11. Handling Precautions

a) Be sure to turn off the power supply when inserting or disconnecting the cable.

b) Be sure to design the cabinet so that the module can be installed without any extra stress such as warp or twist.

c) Since the front polarizer is easily damaged, pay attention not to scratch it.

d) Wipe off water drop immediately. Long contact with water may cause discoloration or spots.

e) When the panel surface is soiled, wipe it with absorbent cotton or other soft cloth.

f) Since the panel is made of glass, it may break or crack if dropped or bumped on hard surface. Handle with care.

g) Since CMOS LSI is used in this module, take care of static electricity and injure the human earth when handling.

h) Observe all other precautionary requirements in handling components.

i) This module has its circuitry PCBs on the rear side and should be handled carefully in order not to be stressed.

j) Laminated film is attached to the module surface to prevent it from being scratched . Peel the film off slowly just before the use with strict attention to electrostatic charges. Ionized air shall be blown over during the action. Blow off the 'dust' on the polarizer by using an ionized nitrogen gun, etc..

12.Reliability test items

No.	Test item	Conditions
1	High temperature storage test	Ta = 70℃ 240h
2	Low temperature storage test	Ta =-30℃ 240h
3	High temperature & high humidity operation test	Ta = 50℃ ;95 %RH 240h
4	High temperature operation test	Ta = 60℃ 240h
5	Low temperature operation test	Ta = 0℃ 240h
6	Vibration test (non- operating)	Frequency: 10～500Hz, 1.0G , 20 min/each axis
7	Shock test (non- operating)	Gravity : 100G Pulse width : 2ms, half sine wave Direction : ±X,±Y,±Z Once for each direction.

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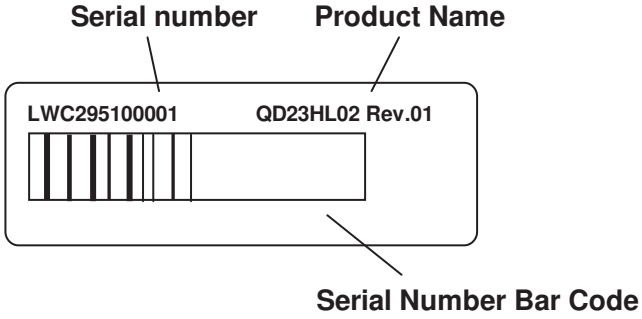
13. Others

1) LCD Module Label:



LWC295100001 Digital code 4, 5 is Date code.

Digital 4 (Year) 1: 2001, 2: 2002, 3:2003,….

Digital 5 (Month) 1: Jan, 2: Feb,… , A:Oct, B:Nov., C: Dec.

2) Adjusting volume has been set optimally before shipment, so do not change any adjusted value. If adjusted value is changed, the specification may not be satisfied.
3) Disassembling the module can cause permanent damage and should be strictly avoided.
4) Please be careful since image retention may occur when a fixed pattern is displayed for a long time.
5) If any problem occurs in relation to the description of this specification, it shall be resolved through discussion with spirit of cooperation.

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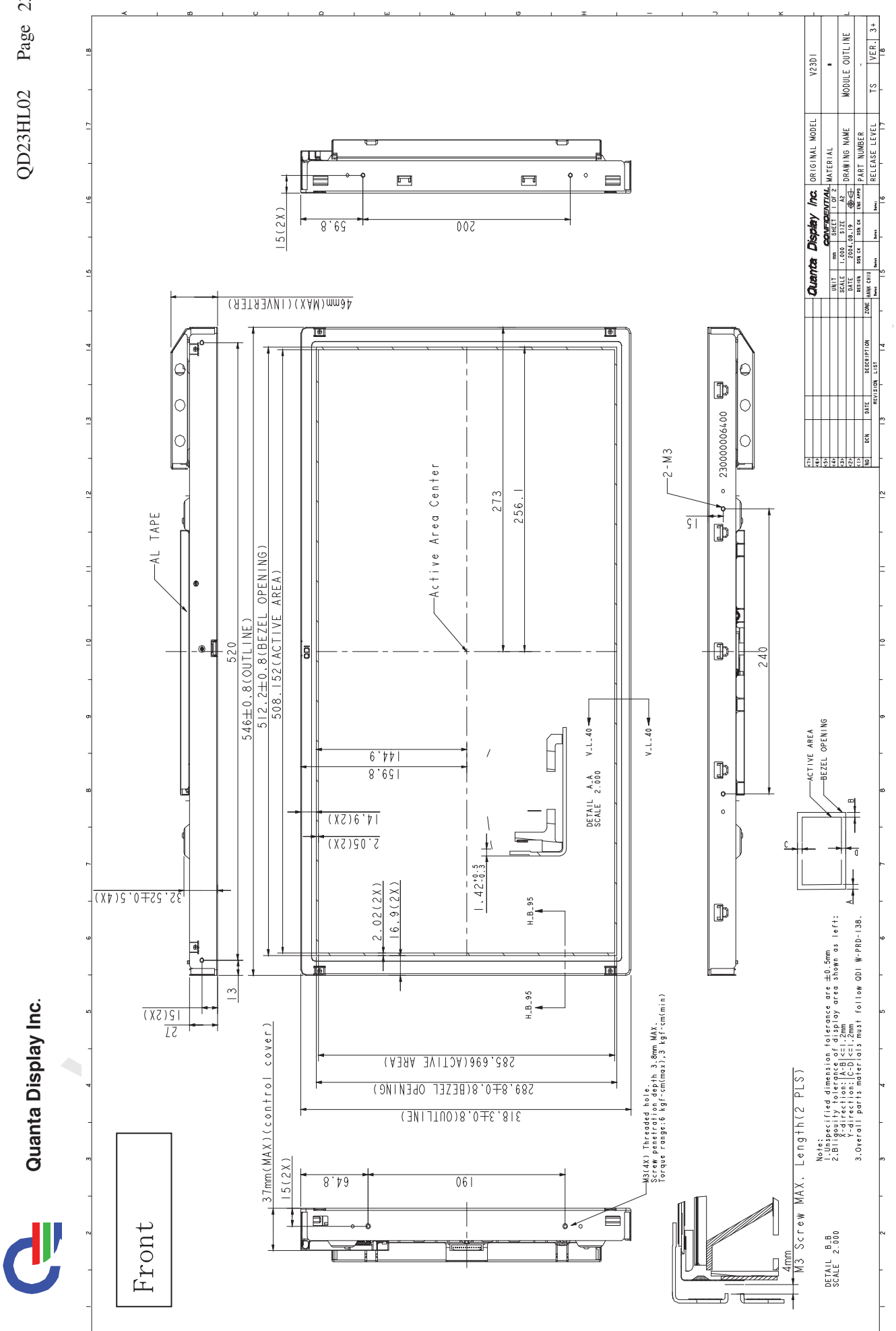
Quanta Display Inc.



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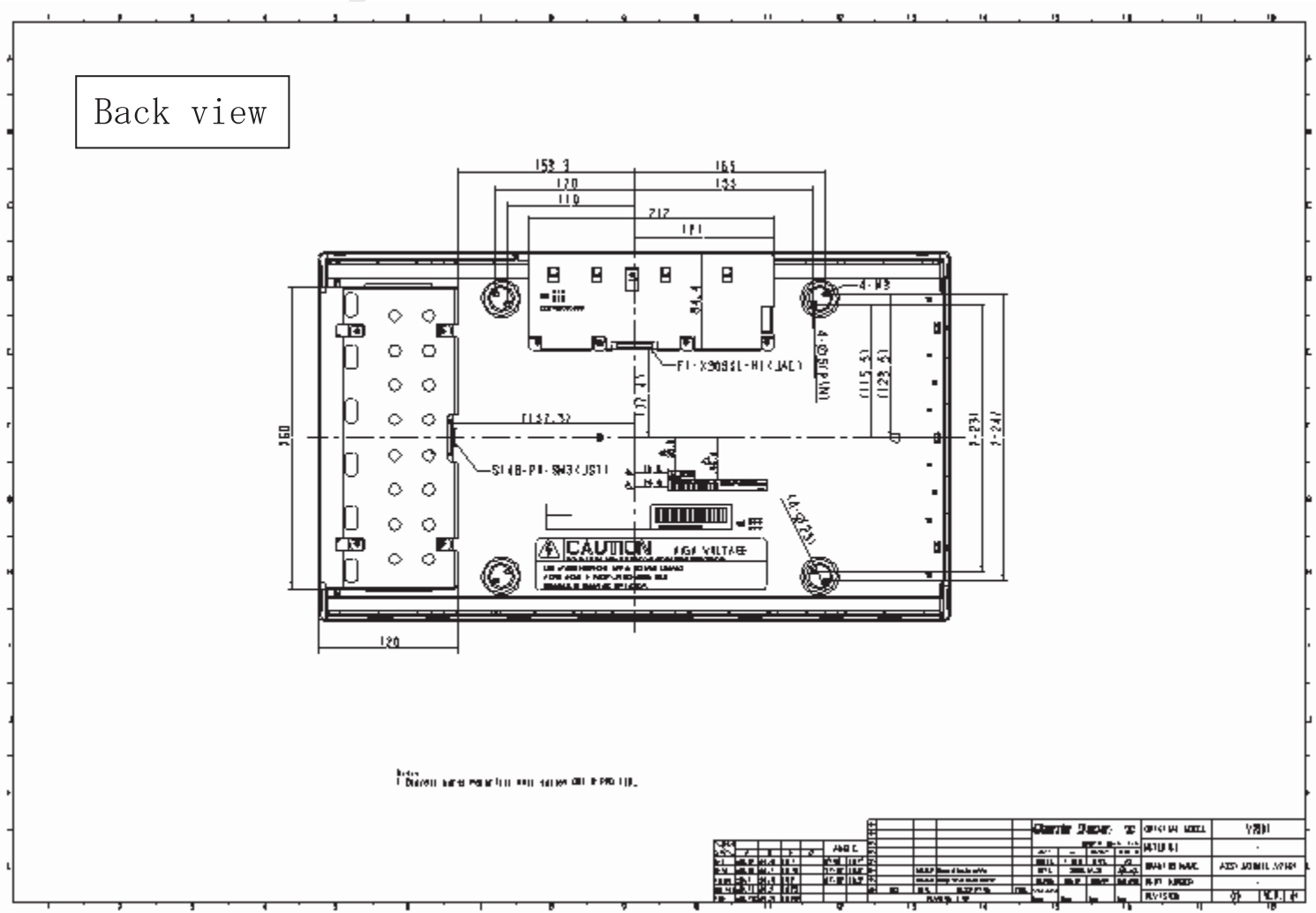

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